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## (54) ELECTRODE PASTE AND METHOD FOR MANUFACTURING ELECTRONIC PART USING IT

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To provide an electrode paste that prevents electrode peeling at cutting, and also prevents floating electrodes after firing and prevents the electrode from falling off when polishing the electronic part, and a method for manufacturing the electronic part using it.

**SOLUTION:** An electrode paste contains at least a butyral resin. An electrode is printed at least either on the top or reverse surface of a laminate having an internal electrode with using the electrode paste. Then, the laminate where the electrode is printed is cut into each piece, and the cut laminate is heat treated. A plasticizer in the laminate is removed, and the laminate that the plasticizer is removed is barrel-polished. Then, the laminate barrel-polished is fired.

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(54)【発明の名称】電極ペースト及びそれを用いた電子部品の製造方法

(57)【要約】

【課題】電子部品の切断時の電極剥離を防止すると共に  
焼成後の電極の浮きを防止し、また、電子部品の研磨時  
の電極脱落を防止することができる電極ペースト及び  
それを用いた電子部品の製造方法を提供する。

【解決手段】少なくともブチラール樹脂を含有する電極  
ペーストを準備し、内部電極を有する積層体の少なくとも  
表裏面のどちらかに、前記電極ペーストを用いて電極  
を印刷し、次に、前記電極が印刷された積層体を個片に  
切断し、前記切断された積層体を熱処理して、前記積層  
体中の可塑剤を除去し、前記可塑剤を除去した積層体を  
バレル研磨し、その後、前記バレル研磨された積層体を  
焼成する。

## 【特許請求の範囲】

【請求項1】 金属粒子、樹脂及び溶剤を少なくとも含む電極ペーストであって、前記電極ペーストがブチラール樹脂を含有することを特徴とする電極ペースト。

【請求項2】 前記電極ペーストが、ブチラール樹脂を0.2～1.0質量%含有する請求項1に記載の電極ペースト。

【請求項3】 前記金属粒子が、金、銀、白金及びパラジウムの中から選ばれる少なくとも1つからなる請求項1又は2に記載の電極ペースト。

【請求項4】 前記金属粒子が、70～90質量%含有されている請求項1～3のいずれかに記載の電極ペースト。

【請求項5】 前記金属粒子の形状が球形で、その平均粒径が0.3～5μmの範囲にある請求項1～4のいずれかに記載の電極ペースト。

【請求項6】 少なくともブチラール樹脂を含有する電極ペーストを準備し、

内部電極を有する積層体の少なくとも表裏面のどちらかに、前記電極ペーストを用いて電極を印刷し、

次に、前記電極が印刷された積層体を個片に切断し、その後、前記切断された積層体を焼成することを特徴とする電子部品の製造方法。

【請求項7】 少なくともブチラール樹脂を含有する電極ペーストを準備し、内部電極と内部ビアを有する積層体の少なくとも表裏面のどちらかに、前記電極ペーストを用いて電極を印刷し、

次に、前記電極が印刷された積層体を個片に切断し、その後、前記切断された積層体を焼成することを特徴とする電子部品の製造方法。

【請求項8】 少なくともブチラール樹脂を含有する電極ペーストを準備し、

内部電極を有する積層体の少なくとも表裏面のどちらかに、前記電極ペーストを用いて電極を印刷し、

次に、前記電極が印刷された積層体を個片に切断し、前記切断された積層体を大気中で熱処理して、前記積層体中の可塑剤を除去し、

前記可塑剤を除去した積層体をバーレル研磨し、

その後、前記バーレル研磨された積層体を焼成することを特徴とする電子部品の製造方法。

【請求項9】 少なくともブチラール樹脂を含有する電極ペーストを準備し、

内部電極を有する積層体の少なくとも表裏面のどちらかに、前記電極ペーストを用いて電極を印刷し、

次に、前記電極が印刷された積層体を個片に切断し、

前記切断された積層体を窒素中で熱処理して、前記積層体中の可塑剤を除去し、

前記可塑剤を除去した積層体をバーレル研磨し、

その後、前記バーレル研磨された積層体を焼成することを特徴とする電子部品の製造方法。

【請求項10】 少なくともブチラール樹脂を含有する電極ペーストを準備し、

内部電極及び内部ビアを有する積層体の少なくとも表裏面のどちらかに、前記電極ペーストを用いて電極を印刷し、

次に、前記電極が印刷された積層体を個片に切断し、前記切断された積層体を大気中で熱処理して、前記積層体中の可塑剤を除去し、

前記可塑剤を除去した積層体をバーレル研磨し、

その後、前記バーレル研磨された積層体を焼成することを特徴とする電子部品の製造方法。

【請求項11】 少なくともブチラール樹脂を含有する電極ペーストを準備し、

内部電極及び内部ビアを有する積層体の少なくとも表裏面のどちらかに、前記電極ペーストを用いて電極を印刷し、

次に、前記電極が印刷された積層体を個片に切断し、前記切断された積層体を窒素中で熱処理して、前記積層体中の可塑剤を除去し、

前記可塑剤を除去した積層体をバーレル研磨し、

その後、前記バーレル研磨された積層体を焼成することを特徴とする電子部品の製造方法。

## 【発明の詳細な説明】

## 【0001】

【発明の属する技術分野】 本発明は、積層LC複合部品等の電子部品に用いる電極ペースト及びそれを用いた電子部品の製造方法に関するものである。

## 【0002】

【従来の技術】 近年、携帯電話など通信分野に使用される電子部品の小型化、高周波化が進むに伴い、コンデンサ、コイルを一つの部品内に集積させた積層LC複合部品が用いられるようになっている。これらの積層LC複合部品は、低誘電率の絶縁体層内に内部電極によって形成したコンデンサ、コイルを互いに結線して用いている。具体的に説明すると、図1に示すような回路を図2、図3、図4のように積層LC複合部品内部に持たせている。図1～4に示したものは一段のローパスフィルタであって、絶縁体層1に内部電極2～5によりコンデンサC1、C2とコイルL1を形成して図1に示すような回路を構築している。なお、6～9は外部電極で、10～13は表層電極、14～17は裏面電極である。

【0003】 また、図6に示すような回路は、図7、図8、図9のように、内部に接続用のビアによる層間接続を有し、LCを積層LC複合部品内部に持たせ、且つ表層にコンデンサ等のチップ部品を実装している。図7～9に示したものは2段のローパスフィルタであって、絶縁体層1に内部電極102～105によりコンデンサC1、C3とコイルL1、L2を形成し、コンデンサC2はチップ部品120を表面に実装して図6に示すような回路を構築している。なお、106～109は外部電

極、110～113は表層電極、114～117は裏面電極、118はビア電極である。

【0004】以上のような一般的な表裏面に電極が形成された積層LC複合部品を作製する方法は、複数枚のセラミックグリーンシート上に、内部電極ペーストを用いてそれぞれの電極パターンを印刷し、所定の位置に積層し、個片に切断、焼成した後、表裏面に電極を形成してもう一度焼成し、外部電極を形成して積層LC複合部品を作製するものである。

【0005】また、複数枚のセラミックグリーンシート上に、内部電極ペーストを用いてそれぞれの電極パターンを印刷し、所定の位置に積層し、工程の簡略化のために先に表裏面に電極を電極ペーストを用いて形成して、個片に切断、焼成した後、外部電極を形成して積層LC複合部品を作製する方法もある。

【0006】また、内部に接続用のビアを含んだ積層LC複合部品の場合、電極パターンの形成前に、パンチングやレーザを用いてセラミックグリーンシートに穴をあける工程と、それに電極材料を充填する工程が追加される。

【0007】更に、積層LC複合部品の角のチッピングを防止するために、外部電極形成前に、バレル研磨を行ない、角の部分を強制的に落とす工程を行なっている。

【0008】

【発明が解決しようとする課題】しかし、表裏面に電極を焼成後に形成する場合には、セラミックの収縮のばらつきによる印刷精度の低下の問題と、個片に印刷するために小さなチップを整列させる煩雑な工程を必要とするという問題がある。一方、それに対し、焼成前に表裏面に電極を印刷して電極部分を切断する方法においては、切断時の表裏面の電極のはがれと、焼成後の電極の浮きが問題となる。

【0009】また、積層LC複合部品はその性格上一般的な電子部品（積層チップコンデンサやチップ抵抗等）と比較して面積が数倍となる。このためセラミックの角の部分が欠けるチッピングにより、セラミックの割れが問題となる。このため、積層LC複合部品のチッピング防止、強度改善のために、焼成後にバレル研磨を行ない、角の部分を落とすことで、チッピングの防止と割れ強度が改善される。しかし、長時間のバレル研磨においては表裏面電極の脱落が顕著となり、半田付け性が困難になるという問題がある。

【0010】そこで、本発明は前記従来の問題を解決するため、電極ペーストの組成を改善することにより電子部品の切断時の電極剥離を防止すると共に焼成後の電極の浮きを防止し、また、電子部品の研磨時の電極脱落を防止することができる電極ペースト及びそれを用いた電子部品の製造方法を提供することを目的とする。

【0011】

【課題を解決するための手段】前記目的を達成するた

め、本発明の電極ペーストは、金属粒子、樹脂及び溶剤を少なくとも含む電極ペーストであって、前記電極ペーストがブチラール樹脂を含有することを特徴とする。

【0012】また、本発明の電極ペーストは、ブチラール樹脂を0.2～1.0質量%含有することが好ましい。ブチラール樹脂の含有量が0.2質量%を下回ると密着性に問題があり、1.0質量%を超えると溶剤への溶解が困難になる問題がある。

【0013】また、本発明の電極ペーストは、前記金属粒子が金、銀、白金及びパラジウムの中から選ばれる少なくとも1つからなることが好ましい。

【0014】また、本発明の電極ペーストは、前記金属粒子を70～90質量%含有することが好ましい。

【0015】また、本発明の電極ペーストは、前記金属粒子の形状が球形で、その平均粒径が0.3～5μmの範囲にあることが好ましい。

【0016】更に、本発明の電極ペーストを用いた電子部品の製造方法は、少なくともブチラール樹脂を含有する電極ペーストを準備し、内部電極を有する積層体の少なくとも表裏面のどちらかに、前記電極ペーストを用いて電極を印刷し、次に、前記電極が印刷された積層体を個片に切断し、その後、前記切断された積層体を焼成することを特徴とする。

【0017】また、本発明の電極ペーストを用いた電子部品の製造方法は、少なくともブチラール樹脂を含有する電極ペーストを準備し、内部電極と内部ビアを有する積層体の少なくとも表裏面のどちらかに、前記電極ペーストを用いて電極を印刷し、次に、前記電極が印刷された積層体を個片に切断し、その後、前記切断された積層体を焼成することを特徴とする。

【0018】以上より、電極ペースト中にブチラール樹脂を添加することにより、電極ペーストと積層体との密着力が向上し、積層体を切断する工程で表裏面の電極の剥離を防止できると共に焼成後の電極の浮きを防止できる。

【0019】また、本発明の電極ペーストを用いた電子部品の製造方法は、少なくともブチラール樹脂を含有する電極ペーストを準備し、内部電極を有する積層体の少なくとも表裏面のどちらかに、前記電極ペーストを用いて電極を印刷し、次に、前記電極が印刷された積層体を個片に切断し、前記切断された積層体を大気中で熱処理して、前記積層体中の可塑剤を除去し、前記可塑剤を除去した積層体をバレル研磨し、その後、前記バレル研磨された積層体を焼成することを特徴とする。

【0020】また、本発明の電極ペーストを用いた電子部品の製造方法は、少なくともブチラール樹脂を含有する電極ペーストを準備し、内部電極を有する積層体の少なくとも表裏面のどちらかに、前記電極ペーストを用いて電極を印刷し、次に、前記電極が印刷された積層体を個片に切断し、前記切断された積層体を窒素中で熱処理

して、前記積層体中の可塑剤を除去し、前記可塑剤を除去した積層体をバレル研磨し、その後、前記バレル研磨された積層体を焼成することを特徴とする。

【0021】また、本発明の電極ペーストを用いた電子部品の製造方法は、少なくともブチラール樹脂を含有する電極ペーストを準備し、内部電極及び内部ビアを有する積層体の少なくとも表裏面のどちらかに、前記電極ペーストを用いて電極を印刷し、次に、前記電極が印刷された積層体を個片に切断し、前記切断された積層体を大気中で熱処理して、前記積層体中の可塑剤を除去し、前記可塑剤を除去した積層体をバレル研磨し、その後、前記バレル研磨された積層体を焼成することを特徴とする。

【0022】また、本発明の電極ペーストを用いた電子部品の製造方法は、少なくともブチラール樹脂を含有する電極ペーストを準備し、内部電極及び内部ビアを有する積層体の少なくとも表裏面のどちらかに、前記電極ペーストを用いて電極を印刷し、次に、前記電極が印刷された積層体を個片に切断し、前記切断された積層体を窒素中で熱処理して、前記積層体中の可塑剤を除去し、前記可塑剤を除去した積層体をバレル研磨し、その後、前記バレル研磨された積層体を焼成することを特徴とする。

【0023】以上より、電極ペースト中にブチラール樹脂を添加することにより、電極ペーストと積層体との密着力が向上し、積層体をバレル研磨する工程で表裏面の電極の剥離を防止できる。

【0024】また、バレル研磨時における研磨剤と電極との衝突をブチラール樹脂が緩和する効果もあり、これにより更に積層体の電極の剥離を防止できる。なお、積層体を焼成後にバレル研磨を行なうと、焼成によりブチラール樹脂が消失してしまうため、前記ブチラール樹脂によるバレル研磨時の衝突緩和効果が期待できない。

#### 【0025】

【発明の実施の形態】以下、本発明の実施の形態について説明する。

【0026】本発明は、金属粒子、樹脂及び溶剤を少な

くとも含む電極ペーストであって、前記電極ペーストがブチラール樹脂を含有することを特徴とする電極ペーストである。

【0027】前記金属粒子としては、金、銀、白金及びパラジウムの中から選ばれる少なくとも1つを使用でき、その量としては電極ペースト中に70～90質量%含有させることが好ましい。また、前記金属粒子の形状は球形で、その平均粒径が0.3～5μmの範囲にあることが好ましい。

【0028】前記樹脂としては、電極ペースト中に少なくとも0.2～1.0質量%のブチラール樹脂を使用し、通常ブチラール樹脂以外の樹脂も用いる。ブチラール樹脂以外の樹脂としては、エチルセルロース、セルロース誘導体、ニトロセルロース、ヒトロキシプロピルセルロース等が使用できる。

【0029】また、前記溶剤としては、αターピネオール、DBP(フタル酸ジブチル)、BBP(フタル酸ブチルベンジル)、MIBE(メチルイソブチルエーテル)、ヤブチルラクトン、ブチルカルビトール等が使用できる。

【0030】以下、具体的な本発明の実施例について、図面を参照しながら説明する。

【0031】(実施例1)先ず、本発明の電極ペーストについて説明する。

【0032】金属粒子として各種粒径の銀粉を、樹脂としてBMS積水化学社製のブチラール樹脂及び日新化成社製のエチルセルロース(STD-45)を、溶剤としてαターピネオールをそれぞれ準備した。次に、所定量のエチルセルロースとブチラール樹脂をαターピネオールに溶解させ、ビヒクルとした。続いて、前記各粒径の銀粉を前記ビヒクルと混合して3本ロールミルにて混練し、サンプル1～10の本発明の電極ペーストを作製した。比較のため、ブチラール樹脂を含まない電極ペーストも同様に作製し、サンプル11とした。表1に使用した銀粉の粒径及び電極ペーストの各成分の量を示した。

#### 【0033】

【表1】

サンプル	粒径	銀粉	エチルセルロース	ブチラール樹脂	全樹脂	溶剤
1	1	80	1.0	0.7	1.7	18.3
2	3	80	0.7	0.5	1.2	18.8
3	5	80	0.6	0.4	1.0	19.0
4	8	80	0.5	0.4	0.9	19.1
5	3	70	1.2	0.9	2.1	27.9
6	3	90	0.5	0.4	0.9	9.1
7	3	80	1.0	0.2	1.2	18.8
8	3	80	0.7	0.5	1.2	18.8
9	3	80	0.5	0.7	1.2	18.8
10	3	80	0.2	1.0	1.2	18.8
※11	3	80	1.2	0.0	1.2	18.8

【0034】なお、ブチラール樹脂の含有量が、1.0質量%を超えるとブチラール樹脂のαターピネオールへの溶解が困難となった。

【0035】(実施例2) 次に、実施例1で作製した電極ペーストを用いた電子部品の製造方法を説明する。

【0036】縦100mm、横100mmの大きさの厚み100μmの日本電気硝子社製のグリーンシート(MLS1000)を2枚積層し、その表面に先ず図5(d)のグランドパターン5を京都エレックス社製の銀ペースト(DD1411A-35)を用いて周知のスクリーン印刷法により印刷して乾燥させた。その上面にグリーンシート1枚を積層して図5(c)のコンデンサパターン3、4をスクリーン印刷した。更に、その上面にグリーンシートを14枚積層して図5(b)のつづら折れ状コイルパターン2をスクリーン印刷した。

【0037】最後に、グリーンシートを更に2枚積層して、その最上層に表層電極として図5(a)の表層電極パターン10~13を実施例1で作製した電極ペーストを用いてスクリーン印刷した。更に、反対側の表面に裏面電極として図5(e)の裏面電極パターン14~17をスクリーン印刷し、表裏面電極と内部電極が形成された積層体を作製した。

【0038】その後、この積層体を80°C、300kg/cm<sup>2</sup>の圧力で1分間熱圧着した。これにより断面が図3、4に示すような積層LC複合部品が作製できた。なお、図1は本発明の実施例2の積層LC複合部品の回路図であり、図2は本発明の実施例2の積層LC複合部品の斜視図である。

【0039】次に、この積層体をブレード刃を用いて縦5mm、横7mmの個片に切断した。切断した積層体の表裏面の電極部分を観察したところ、ブチラール樹脂を添加していないサンプル11の電極ペーストを用いたものでは、電極の一部がブレード刃との摩擦で剥離した。それに対して、ブチラール樹脂を添加したサンプル1~10の電極ペーストを用いたものでは、少し弾性特性を持ったブチラール樹脂とグリーンシートの密着力により、切断部分の電極の剥離は見られなかった。

【0040】その後、上記積層体を大気中で400°Cの温度で熱処理してグリーンシート中のバインダーを除去した後、875°Cで30分間保持して焼成した。外部電極として市販のガラスフリット入り銀電極を側面に所望の形状に塗布し、750°Cで10分間保持して焼き付けた。ブチラール樹脂を添加しないサンプル11の電極ペーストを用いたものでは、焼成前の電極の剥離の形状が焼成後も残り、外部電極と一部の表層電極の間で導通がとれなかった。一方、ブチラール樹脂を添加したサンプル1~10の電極ペーストを用いたものでは、表層電極の切断面での剥離ではなく、焼成後の外部電極の剥離もなく、本発明のブチラール樹脂を添加した電極ペーストでは安定した導通が可能であった。

【0041】また、電極ペーストに用いた銀粉に換えて、同様に金、白金及びパラジウムの粉末をそれぞれペースト化し、ブチラール樹脂を添加して用いたが、銀粉と同様の効果が得られた。

【0042】(実施例3) 実施例1と同様にして内部電極、表裏面電極を形成した積層体を作製した。この積層体を縦7mm、横5mmの個片のサイズにブレード刃を用いて切断した。これを乾燥機を用いて大気中で温度200°C、3時間熱処理し、グリーンシート中の可塑剤を除去した。なお、この条件では、若干の可塑剤が残留し、また若干のバインダーが焼失するが、実用上問題はない。

【0043】次に、この切断した積層体を600cm<sup>3</sup>の容量の直径100mmのポリポットに入れ、直径2mmのアルミナボール及び水を加えてバレル回転数500回/分で1時間バレル研磨を行なった。バレル研磨を焼結前に行なうことで、角が丸くなり、安定した形状を得ることができた。一方、熱処理前にバレル研磨した場合には、グリーンシート中の可塑剤の弾性のために角は丸くならなかった。

【0044】また、ブチラール樹脂を添加しないサンプル11の電極ペーストを用いたものでは、バレル研磨後に表面の電極が研磨されて消失した。それに対し、本発明のブチラール樹脂を添加したサンプル1~10の電極ペーストを用いたものでは、ブチラール樹脂の弾性のためにバレル研磨後においても表面の電極が消失しなかった。

【0045】その後、バレル研磨した個片を乾燥した後、大気中で温度400°Cで熱処理してバインダーを除去した後、875°Cで30分間保持して焼成した。次に、外部電極として市販のガラスフリット入り銀電極を側面に所望の形状に塗布し、750°Cで10分間保持して焼き付けた。実施例1と同様に、表裏面の電極に剥がれがなく、本発明のブチラール樹脂を添加した電極ペーストでは安定した導通が可能である。

【0046】焼成後にバレル研磨を行なった場合に比べて、本発明の製造方法である可塑剤を乾燥後にバレル研磨を行ない、その後焼成することで、表面荒さが1/5に減少し、抗折強度が30%向上して極めて良好な特性が得られた。

【0047】また、電極ペーストに用いた銀粉に換えて、同様に金、白金及びパラジウムの粉末をそれぞれペースト化し、ブチラール樹脂を添加して用いたが、銀粉と同様の効果が得られた。

【0048】(実施例4) 実施例1と同様にして内部電極、表裏面電極を形成した積層体を作製した。この積層体を縦7mm、横5mmの個片のサイズにブレード刃を用いて切断した。これを、乾燥機を用いて大気を窒素に置換し、窒素中で温度200°C、3時間熱処理し、グリーンシート中の可塑剤を除去させた。

【0049】この様に、窒素中で熱処理することで、グリーンシート中の可塑剤を乾燥させると共に、エチルセルロース、ブチラール樹脂の燃焼を抑制することが可能となり、試料を多量に投入しても安定した乾燥が可能となる。

【0050】次に、この切断した積層体を600cm<sup>3</sup>の容量の直径100mmのポリポットに入れ、直径2mのアルミナボール及び水を加えてバレル回転数500回/分で1時間バレル研磨を行なった。バレル研磨を焼結前に行なうことで、角が丸くなり、安定した形状を得ることができた。一方、熱処理前にバレル研磨した場合には、グリーンシート中の可塑剤の弾性のために角は丸くならなかった。

【0051】また、ブチラール樹脂を添加しないサンプル11の電極ペーストを用いたものでは、バレル研磨後に表面の電極が研磨されて消失した。それに対し、本発明のブチラール樹脂を添加したサンプル1~10の電極ペーストを用いたものでは、ブチラール樹脂の弾性のためにバレル研磨後においても表面の電極が消失しなかった。

【0052】その後、バレル研磨した個片を乾燥した後、大気中で温度400°Cで熱処理してバインダーを除去した後、875°Cで30分間保持して焼成した。次に、外部電極として市販のガラスフリット入り銀電極を側面に所望の形状に塗布し、750°Cで10分間保持して焼き付けた。ブチラール樹脂を添加しないサンプル11の電極ペーストを用いたものでは、焼成前の電極の剥離の形状が焼成後も残り、外部電極と一部の表層電極の間で導通がとれなかった。一方、ブチラール樹脂を添加したサンプル1~10の電極ペーストを用いたものは、表層電極の切断面での剥離ではなく、焼成後の外部電極の剥離もなく、本発明のブチラール樹脂を添加した電極ペーストでは安定した導通が可能であった。

【0053】焼成後にバレル研磨を行なった場合に比べて、本発明の製造方法である可塑剤を乾燥後にバレル研磨を行ない、その後焼成することで、表面荒さが1/5に減少し、抗折強度が30%向上して極めて良好な特性が得られた。

【0054】また、電極ペーストに用いた銀粉に換えて、同様に金、白金及びパラジウムの粉末をそれぞれペースト化し、ブチラール樹脂を添加して用いたが、銀粉と同様の効果が得られた。

【0055】(実施例5) 次に、内部電極の接続に内部ビアホールを用いた電子部品の製造方法を説明する。

【0056】縦100mm、横100mmの大きさの厚み100μmの日本電気硝子社製のグリーンシート(MLS1000)を2枚積層し、その表面に先ず図10(d)のグランドパターン105を京都エレックス社製の銀ペースト(DD1411A-35)を用いて周知のスクリーン印刷法により印刷して乾燥させた。その上面

にグリーンシート1枚を積層して図10(c)のコンデンサパターン103、104をスクリーン印刷した。更に、その上面にグリーンシートを14枚積層して図10(b)のつづら折れ状コイルパターン102をスクリーン印刷した。

【0057】次に、内部ビアの接続が必要なグリーンシートの所定の位置に、直径0.2mmのパンチングによる穴加工を行ない、位置合わせをしながら各パターンを形成したグリーンシートを積層後、その最上層の内部ビアの部分のみが露出するようにメタルマスクを通して銀ペーストを印刷して乾燥させた。

【0058】最後に、グリーンシートを更に2枚積層して、その最上層に表層電極として図10(a)の表層電極パターン110~113を実施例1で作製した電極ペーストを用いてスクリーン印刷した。更に、反対側の表面に裏面電極として図10(e)の裏面電極パターン114~117をスクリーン印刷し、表裏面電極、内部電極及び内部ビアが形成された積層体を作製した。

【0059】その後、この積層体を80°C、300kg/cm<sup>2</sup>の圧力で1分間熱圧着した。これにより断面が図8、9に示すような積層LC複合部品が作製できた。なお、図6は本発明の実施例5の積層LC複合部品の回路図であり、図7は本発明の実施例5の積層LC複合部品の斜視図である。

【0060】以下、実施例2、3、4と同様の方法で試料を作製した。実施例2、3、4と同様に、本発明のブチラール樹脂を添加した電極ペーストを用いたものは安定した導通が可能であった。

【0061】焼成後にバレル研磨を行なった場合に比べて、本発明の製造方法である可塑剤を乾燥後にバレル研磨を行ない、その後焼成することで、表面荒さが1/5に減少し、抗折強度が30%向上して極めて良好な特性が得られた。

【0062】また、電極ペーストに用いた銀粉に換えて、同様に金、白金及びパラジウムの粉末をそれぞれペースト化し、ブチラール樹脂を添加して用いたが、銀粉と同様の効果が得られた。

【0063】

【発明の効果】以上のように本発明においては、電極ペーストの組成を改善することにより電子部品の切断時の電極剥離を防止しと共に、電子部品の研磨時の電極脱落を防止することができ、また可塑剤を除いた後、焼成前にバレル研磨を行なうことにより高強度の電子部品を得ることができる。

【図面の簡単な説明】

【図1】本発明の実施例2の積層LC複合部品の回路図である。

【図2】本発明の実施例2の積層LC複合部品の斜視図である。

【図3】図2のI-I線断面図である。

【図4】図2のI—I線断面図である。

【図5】本発明の実施例2の積層LC複合部品の印刷パターン図である。

【図6】本発明の実施例5の積層LC複合部品の回路図である。

【図7】本発明の実施例5の積層LC複合部品の斜視図である。

【図8】図7のI—I線断面図である。

【図9】図7のI—I—I—I線断面図である。

【図10】本発明の実施例5の積層LC複合部品の印刷パターン図である。

【符号の説明】

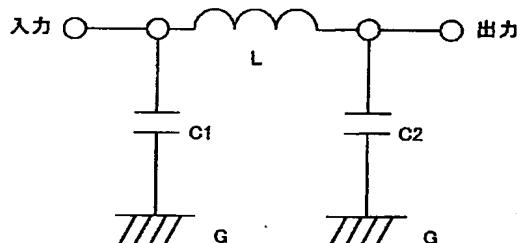
1 絶縁体層

2	内部電極（コイルパターン）
3、4	内部電極（コンデンサパターン）
5	内部電極（グランドパターン）
6～9	外部電極
10～13	表層電極（表層電極パターン）
14～17	裏面電極（裏面電極パターン）
102	内部電極（コイルパターン）
103、104	内部電極（コンデンサパターン）
105	内部電極（グランドパターン）
106～109	外部電極
110～113	表層電極
114～117	裏面電極

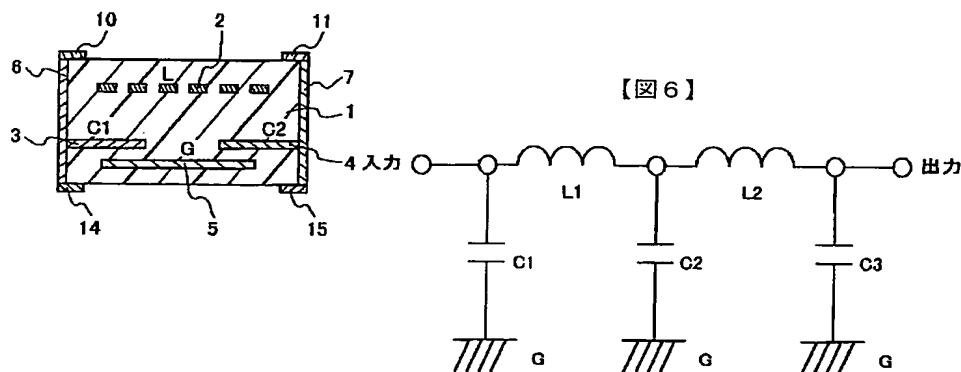
1

絶縁体層

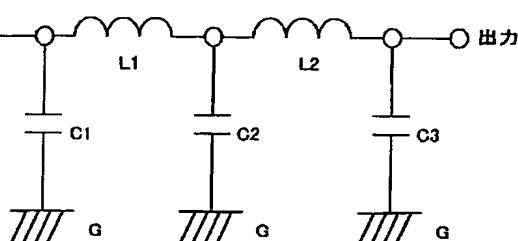
【図1】



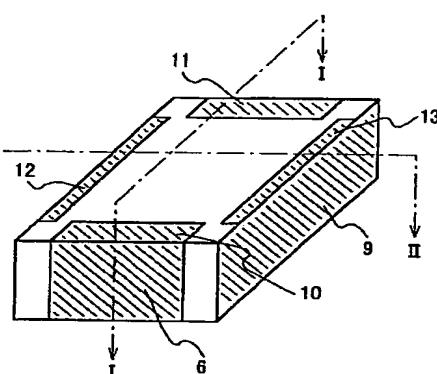
【図3】



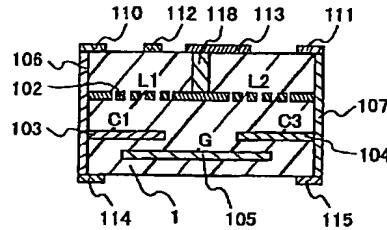
【図6】



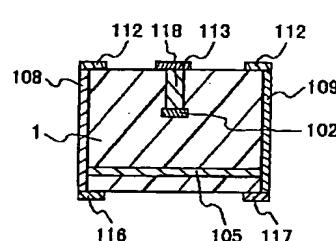
【図4】



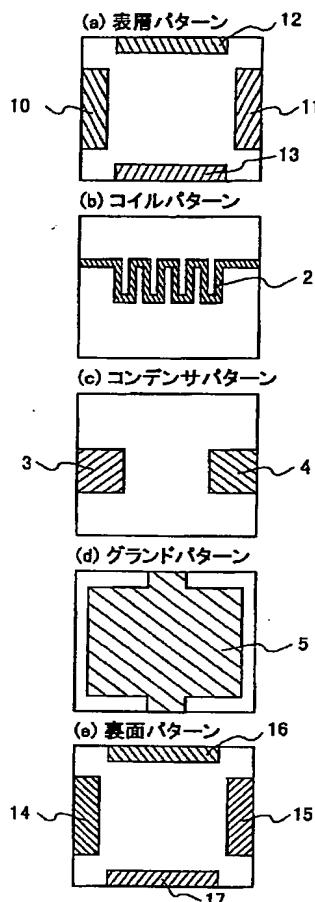
【図8】



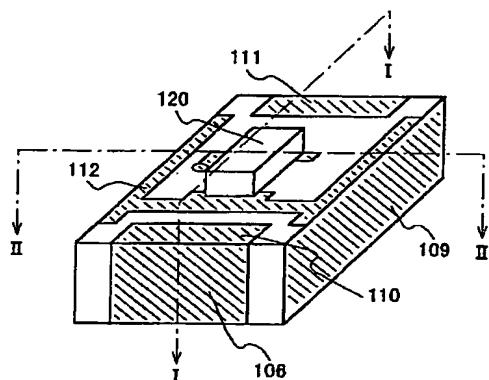
【図9】



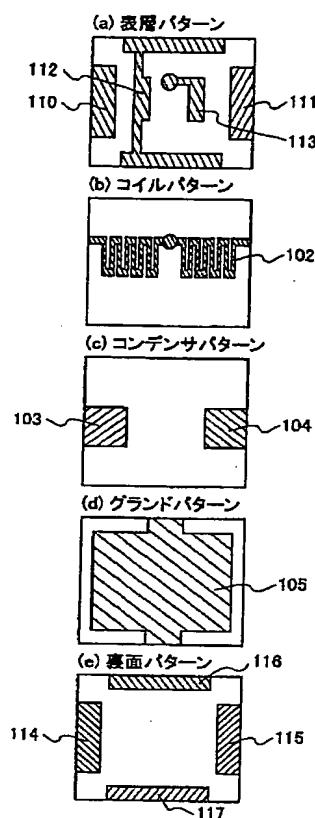
【図5】



【図7】



【図10】



フロントページの続き

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(21)Application number : 2001-050831 (71)Applicant : MATSUSHITA ELECTRIC IND CO LTD  
(22)Date of filing : 26.02.2001 (72)Inventor : KAWAKITA KOJI  
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### (54) ELECTRODE PASTE AND METHOD FOR MANUFACTURING ELECTRONIC PART USING IT

#### (57)Abstract:

**PROBLEM TO BE SOLVED:** To provide an electrode paste that prevents electrode peeling at cutting, and also prevents floating electrodes after firing and prevents the electrode from falling off when polishing the electronic part, and a method for manufacturing the electronic part using it.

**SOLUTION:** An electrode paste contains at least a butyral resin. An electrode is printed at least either on the top or reverse surface of a laminate having an internal electrode with using the electrode paste. Then, the laminate where the electrode is printed is cut into each piece, and the cut laminate is heat treated. A plasticizer in the laminate is removed, and the laminate that the plasticizer is removed is barrel-polished. Then, the laminate barrel-polished is fired.

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#### LEGAL STATUS

[Date of request for examination]

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[Date of requesting appeal against examiner's decision of rejection]

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CLAIMS

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## [Claim(s)]

[Claim 1] Electrode paste which is electrode paste which contains metal particles, resin, and a solvent at least, and is characterized by said electrode paste containing butyral resin.

[Claim 2] Electrode paste according to claim 1 with which said electrode paste does 0.2-1.0 mass % content of butyral resin.

[Claim 3] Electrode paste according to claim 1 or 2 with which said metal particles consist of at least one chosen from gold, silver, platinum, and palladium.

[Claim 4] Electrode paste according to claim 1 to 3 with which 70-90 mass % content of said metal particles is done.

[Claim 5] Electrode paste according to claim 1 to 4 which has the configuration of said metal particles in the range the mean particle diameter of whose is 0.3-5 micrometers in a globular form.

[Claim 6] The manufacture approach of the electronic parts characterized by preparing the electrode paste which contains butyral resin at least, cutting the layered product of the layered product which has an internal electrode which uses said electrode paste for one of the table rear faces, and prints an electrode at least next, by which said electrode was printed to the piece of an individual, and calcinating said cut layered product after that.

[Claim 7] The manufacture approach of the electronic parts characterized by preparing the electrode paste which contains butyral resin at least, cutting the layered product of the layered product which has an internal electrode and internal beer which uses said electrode paste for one of the table rear faces, and prints an electrode at least next, by which said electrode was printed to the piece of an individual, and calcinating said cut layered product after that.

[Claim 8] The layered product which prepares the electrode paste which contains butyral resin at least, and has an internal electrode at least to one of the table rear faces Cut the layered product which prints an electrode using said electrode paste next by which said electrode was printed to the piece of an individual, and said cut layered product is heat-treated in atmospheric air. The manufacture approach of the electronic parts which carry out barrel finishing of the layered product which removed the plasticizer in said layered product and removed said plasticizer, and are characterized by calcinating after that said layered product by which barrel finishing was carried out.

[Claim 9] The layered product which prepares the electrode paste which contains butyral resin at least, and has an internal electrode at least to one of the table rear faces Cut the layered product which prints an electrode using said electrode paste next by which said electrode was printed to the piece of an individual, and said cut layered product is heat-treated in nitrogen. The manufacture approach of the electronic parts which carry out barrel finishing of the layered product which removed the plasticizer in said layered product and removed said plasticizer, and are characterized by calcinating after that said layered product by which barrel finishing was carried out.

[Claim 10] The layered product which prepares the electrode paste which contains butyral resin at least, and has an internal electrode and internal beer at least to one of the table rear faces Cut the layered product which prints an electrode using said electrode paste next by which said electrode was printed to the piece of an individual, and said cut layered product is heat-treated in atmospheric air. The manufacture approach of the electronic parts which carry out barrel finishing of the layered product which removed the plasticizer in said layered product and removed said plasticizer, and are characterized by calcinating after that said layered product by which barrel finishing was carried out.

[Claim 11] The layered product which prepares the electrode paste which contains butyral resin at least, and has an internal electrode and internal beer at least to one of the table rear faces Cut the layered product

which prints an electrode using said electrode paste next by which said electrode was printed to the piece of an individual, and said cut layered product is heat-treated in nitrogen. The manufacture approach of the electronic parts which carry out barrel finishing of the layered product which removed the plasticizer in said layered product and removed said plasticizer, and are characterized by calcinating after that said layered product by which barrel finishing was carried out.

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[Translation done.]

**\* NOTICES \***

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**DETAILED DESCRIPTION**

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**[Detailed Description of the Invention]****[0001]**

[Field of the Invention] This invention relates to the manufacture approach of the electronic parts using the electrode paste and it which are used for electronic parts, such as laminating LC composite part.

**[0002]**

[Description of the Prior Art] In recent years, the miniaturization of the electronic parts used for the communication link fields, such as a cellular phone, and high frequency-ization follow on progressing, and the laminating LC composite part which made the capacitor and the coil accumulate into one component is used. Into the insulator layer of a low dielectric constant, such laminating LC composite part connects the capacitor and coil of each other which were formed with the internal electrode, and they are used for it. If it explains concretely, the circuit as shown in drawing 1 is given to the interior of laminating LC composite part like drawing 2 R> 2, drawing 3 , and drawing 4 . It is one step of low pass filter which was shown in drawing 1 -4, and it is building the circuit as formed capacitors C1 and C2 and Coil L in the insulator layer 1 with internal electrodes 2-5 and shown in drawing 1 . In addition, 6-9 are external electrodes and, as for 10-13, a surface electrode, and 14-17 are rear-face electrodes.

[0003] Moreover, like drawing 7 , drawing 8 R> 8, and drawing 9 , a circuit as shown in drawing 6 has an interlayer connection by the beer for connection inside, and gives LC to the interior of laminating LC composite part, and mounts chips, such as a capacitor, in a surface. It is two steps of low pass filters which were shown in drawing 7 -9, and capacitors C1 and C3 and coils L1 and L2 are formed in the insulator layer 1 with internal electrodes 102-105, and the capacitor C2 is building the circuit as mounted a chip 120 in a front face and shown in drawing 6 . In addition, as for a surface electrode, and 114-117, for 106-109, an external electrode, and 110-113 are [ a rear-face electrode and 118 ] beer electrodes.

[0004] On the ceramic green sheet of two or more sheets, after using an internal electrode paste for the approach of producing the laminating LC composite part with which the electrode was formed in the above general table rear faces, printing each electrode pattern, carrying out a laminating to a position and cutting and calcinating it to the piece of an individual, it forms an electrode in a table rear face, is calcinated once again, forms an external electrode, and produces laminating LC composite part.

[0005] Moreover, there is also the approach of forming an external electrode and producing laminating LC composite part on the ceramic green sheet of two or more sheets, after use an internal electrode paste, print each electrode pattern, carrying out a laminating to a position, using electrode paste for a table rear face, forming an electrode in it previously for simplification of a process and cutting and calcinating to the piece of an individual.

[0006] Moreover, in the case of the laminating LC composite part which contained the beer for connection inside, the process which uses punching and laser and makes a hole before formation of an electrode pattern at a ceramic green sheet, and the process which fills it up with an electrode material are added.

[0007] Furthermore, in order to prevent the chipping of the angle of laminating LC composite part, the process from which barrel finishing is performed and the part of an angle is compulsorily dropped before external electrode formation is performed.

**[0008]**

[Problem(s) to be Solved by the Invention] However, in forming in a table rear face after calcinating an electrode, there are a problem of lowering of the print quality by dispersion in contraction of a ceramic and a problem of needing the complicated process where a chip small in order to print to the piece of an individual is aligned. In the approach of printing an electrode at the table rear face and on the other hand disconnecting an electrode section before baking to it, the float of peeling of the electrode on the rear face of a table at the

time of cutting and the electrode after baking poses a problem.

[0009] Moreover, as compared with the general character top-electronic parts (a laminating chip capacitor, chip resistor, etc.), as for laminating LC composite part, area becomes several times. For this reason, by the chipping which lacks the part of the angle of a ceramic, the crack of a ceramic poses a problem. For this reason, prevention of a chipping and crack reinforcement are improved by performing barrel finishing and dropping the part of an angle after baking, for chipping prevention of laminating LC composite part and an improvement on the strength. However, there is a problem that omission of a table rear-face electrode become remarkable in the barrel finishing of long duration, and soldering nature becomes difficult.

[0010] Then, in order that this invention may solve said conventional problem, it aims at offering the manufacture approach of the electronic parts using the electrode paste and it which can prevent the float of the electrode after baking while preventing the electrode exfoliation at the time of cutting of electronic parts by improving the presentation of electrode paste, and can prevent the electrode omission at the time of polish of electronic parts.

[0011]

[Means for Solving the Problem] In order to attain said object, the electrode paste of this invention is electrode paste which contains metal particles, resin, and a solvent at least, and is characterized by said electrode paste containing butyral resin.

[0012] Moreover, as for the electrode paste of this invention, it is desirable to do 0.2-1.0 mass % content of butyral resin. When the content of butyral resin is less than 0.2 mass %, a problem is in adhesion, and when 1.0 mass % is exceeded, there is a problem to which the dissolution to a solvent becomes difficult.

[0013] Moreover, as for the electrode paste of this invention, it is desirable that said metal particles consist of at least one chosen from gold, silver, platinum, and palladium.

[0014] Moreover, as for the electrode paste of this invention, it is desirable to do 70-90 mass % content of said metal particles.

[0015] Moreover, the configuration of said metal particles is a globular form, and, as for the electrode paste of this invention, it is desirable that it is in the range the mean particle diameter of whose is 0.3-5 micrometers.

[0016] Furthermore, the manufacture approach of the electronic parts using the electrode paste of this invention prepares the electrode paste which contains butyral resin at least, cuts the layered product of the layered product which has an internal electrode which uses said electrode paste for one of the table rear faces, and prints an electrode at least next by which said electrode was printed to the piece of an individual, and is characterized by calcinating said cut layered product after that.

[0017] Moreover, the manufacture approach of the electronic parts using the electrode paste of this invention prepares the electrode paste which contains butyral resin at least, cuts the layered product of the layered product which has an internal electrode and internal beer which uses said electrode paste for one of the table rear faces, and prints an electrode at least next by which said electrode was printed to the piece of an individual, and is characterized by calcinating said cut layered product after that.

[0018] As mentioned above, by adding butyral resin in electrode paste, the adhesion force of electrode paste and a layered product improves, and while being able to prevent exfoliation of the electrode on the rear face of a table at the process which cuts a layered product, the float of the electrode after baking can be prevented.

[0019] Moreover, the manufacture approach of the electronic parts using the electrode paste of this invention The layered product which prepares the electrode paste which contains butyral resin at least, and has an internal electrode at least to one of the table rear faces Cut the layered product which prints an electrode using said electrode paste next by which said electrode was printed to the piece of an individual, and said cut layered product is heat-treated in atmospheric air. Barrel finishing of the layered product which removed the plasticizer in said layered product and removed said plasticizer is carried out, and it is characterized by calcinating after that said layered product by which barrel finishing was carried out.

[0020] Moreover, the manufacture approach of the electronic parts using the electrode paste of this invention The layered product which prepares the electrode paste which contains butyral resin at least, and has an internal electrode at least to one of the table rear faces Cut the layered product which prints an electrode using said electrode paste next by which said electrode was printed to the piece of an individual, and said cut layered product is heat-treated in nitrogen. Barrel finishing of the layered product which removed the plasticizer in said layered product and removed said plasticizer is carried out, and it is characterized by calcinating after that said layered product by which barrel finishing was carried out.

[0021] Moreover, the manufacture approach of the electronic parts using the electrode paste of this

invention The layered product which prepares the electrode paste which contains butyral resin at least, and has an internal electrode and internal beer at least to one of the table rear faces Cut the layered product which prints an electrode using said electrode paste next by which said electrode was printed to the piece of an individual, and said cut layered product is heat-treated in atmospheric air. Barrel finishing of the layered product which removed the plasticizer in said layered product and removed said plasticizer is carried out, and it is characterized by calcinating after that said layered product by which barrel finishing was carried out.

[0022] Moreover, the manufacture approach of the electronic parts using the electrode paste of this invention The layered product which prepares the electrode paste which contains butyral resin at least, and has an internal electrode and internal beer at least to one of the table rear faces Cut the layered product which prints an electrode using said electrode paste next by which said electrode was printed to the piece of an individual, and said cut layered product is heat-treated in nitrogen. Barrel finishing of the layered product which removed the plasticizer in said layered product and removed said plasticizer is carried out, and it is characterized by calcinating after that said layered product by which barrel finishing was carried out.

[0023] As mentioned above, by adding butyral resin in electrode paste, the adhesion force of electrode paste and a layered product improves, and exfoliation of the electrode on the rear face of a table can be prevented at the process which carries out barrel finishing of the layered product.

[0024] Moreover, it is effective in butyral resin easing the collision with the abrasive material and electrode at the time of barrel finishing, and, thereby, exfoliation of the electrode of a layered product can be prevented further. In addition, if barrel finishing is performed after calcinating a layered product, since butyral resin will disappear by baking, the collision relaxation effect at the time of the barrel finishing by said butyral resin is not expectable.

[0025]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained.

[0026] This invention is electrode paste which contains metal particles, resin, and a solvent at least, and is electrode paste characterized by said electrode paste containing butyral resin.

[0027] It is desirable to be able to use at least one chosen from gold, silver, platinum, and palladium as said metal particles, and to do 70-90 mass % content of into electrode paste as the amount. Moreover, the configuration of said metal particles is a globular form, and it is desirable that it is in the range the mean particle diameter of whose is 0.3-5 micrometers.

[0028] As said resin, the butyral resin of at least 0.2 - 1.0 mass % is used into electrode paste, and resin other than butyral resin is also usually used. As resin other than butyral resin, ethyl cellulose, a cellulosic, a nitrocellulose, a HITOKOKISHI propyl cellulose, etc. can be used.

[0029] Moreover, as said solvent, alpha terpineol, DBP (dibutyl phtalate) and BBP (phthalic acid benzyl butyl ester), MIBE (methyl isobutyl ether), gamma butyl lactone, butyl carbitol, etc. can be used.

[0030] Hereafter, the example of concrete this invention is explained, referring to a drawing.

[0031] (Example 1) The electrode paste of this invention is explained first.

[0032] The butyral resin by BMS Sekisui Chemical Co., Ltd. and the ethyl cellulose (STD-45) by Nissin Chemicals were prepared for the silver dust of various particle size as resin as metal particles, and alpha terpineol was prepared as a solvent, respectively. Next, the ethyl cellulose and butyral resin of the specified quantity were dissolved in alpha terpineol, and it considered as the vehicle. Then, the silver dust of each of said particle size was mixed with said vehicle, it kneaded in 3 roll mills, and the electrode paste of this invention of samples 1-10 was produced. For the comparison, the electrode paste which does not contain butyral resin was produced similarly, and was made into the sample 11. The particle size of the silver dust used for a table 1 and the amount of each component of electrode paste were shown.

[0033]

[A table 1]

サンプル	粒径	銀粉	エチルセルロース	ブチラル樹脂	全樹脂	溶剤
1	1	80	1.0	0.7	1.7	18.3
2	3	80	0.7	0.5	1.2	18.8
3	5	80	0.6	0.4	1.0	19.0
4	8	80	0.5	0.4	0.9	19.1
5	3	70	1.2	0.9	2.1	27.9
6	3	90	0.5	0.4	0.9	9.1
7	3	80	1.0	0.2	1.2	18.8
8	3	80	0.7	0.5	1.2	18.8
9	3	80	0.5	0.7	1.2	18.8
10	3	80	0.2	1.0	1.2	18.8
※11	3	80	1.2	0.0	1.2	18.8

[0034] In addition, when the content of butyral resin exceeded 1.0 mass %, the dissolution to alpha terpineol of butyral resin became difficult.

[0035] (Example 2) Next, the manufacture approach of the electronic parts using the electrode paste produced in the example 1 is explained.

[0036] The silver paste made from Kyoto EREKKUSU (DD1411A-35) is first used for the front face for the grand pattern 5 of drawing 5 (d), and it printed with well-known screen printing, and was made to carry out the two-sheet laminating of 100mm long and the green sheet (MLS1000) by Nippon Electric Glass Co., Ltd. with a thickness [ of 100mm wide magnitude ] of 100 micrometers, and to dry. The laminating of the one green sheet was carried out to the top face, and the capacitor patterns 3 and 4 of drawing 5 (c) were screen-stenciled. Furthermore, the 14-sheet laminating of the green sheet was carried out to the top face, and the letter coil pattern 2 of a \*\* face crease of drawing 5 (b) was screen-stenciled.

[0037] The two more sheet laminating of the green sheet was carried out to the last, and it screen-stenciled using the electrode paste which produced the surface electrode patterns 10-13 of drawing 5 (a) in the example 1 as a surface electrode in the maximum upper layer. Furthermore, the rear-face electrode patterns 14-17 of drawing 5 (e) were screen-stenciled as a rear-face electrode on the surface of the opposite hand, and the layered product in which the table rear-face electrode and the internal electrode were formed was produced.

[0038] Then, thermocompression bonding of this layered product was carried out for 1 minute by 80 degrees C and the pressure of 300kg/cm<sup>2</sup>. Laminating LC composite part as a cross section shows by this to drawing 3 and 4 was producible. In addition, drawing 1 is the circuit diagram of the laminating LC composite part of the example 2 of this invention, and drawing 2 is the perspective view of the laminating LC composite part of the example 2 of this invention.

[0039] Next, this layered product was cut to 5mm long and the 7mm wide piece of an individual using the blade cutting edge. When the electrode section on the cut rear face of a table of a layered product was observed, at the thing using the electrode paste of the sample 11 which has not added butyral resin, some electrodes exfoliated in friction with a blade cutting edge. By the thing using the electrode paste of the samples 1-10 which added butyral resin, exfoliation of the electrode of a cutting part was not seen to it according to the adhesion force of butyral resin and a green sheet which had elasticity for a while.

[0040] Then, after heat-treating the above-mentioned layered product at the temperature of 400 degrees C in atmospheric air and removing the binder in a green sheet, at 875 degrees C, it held for 30 minutes and calcinated. It applied to the configuration of a request of the commercial silver electrode containing a glass frit on a side face as an external electrode, and at 750 degrees C, it held for 10 minutes and was able to be burned. In the thing using the electrode paste of the sample 11 which does not add butyral resin, it remained, even after the configuration of exfoliation of the electrode before baking calcinating, and a flow was not able to be taken between an external electrode and some surface electrodes. In the thing using the electrode paste of the samples 1-10 which added butyral resin on the other hand, the flow stabilized in the electrode paste which there is not, and exfoliation of the external electrode after baking does not have, either, and added the butyral resin of this invention was possible for exfoliation in the cutting plane of a surface electrode.

[0041] Moreover, it changed to the silver dust used for electrode paste, and the powder of gold, platinum, and palladium was pasted similarly, respectively, and although butyral resin was added and used, the same

effectiveness as silver dust was acquired.

[0042] (Example 3) The layered product which formed the internal electrode and the table rear-face electrode like the example 1 was produced. In the size of 7mm long and the 5mm wide piece of an individual, the blade cutting edge was used and this layered product was cut. This was heat-treated the temperature of 200 degrees C in atmospheric air for 3 hours using the dryer, and the plasticizer in a green sheet was removed. In addition, although some plasticizer remains and some binder is burned down by this condition, it is satisfactory practically.

[0043] Next, this cut layered product was put into the with a 600cm diameter [ 100mm diameter of the capacity of 3 ] poly pot, alumina balls with a diameter of 2mm and water were added, and barrel finishing was performed by part for 500 barrel engine-speeds/for 1 hour. By carrying out, before sintering barrel finishing, the angle was able to become round and the stable configuration was able to be acquired. On the other hand, when barrel finishing was carried out before heat treatment, the angle did not benefit the elasticity of the plasticizer in a green sheet round.

[0044] Moreover, in the thing using the electrode paste of the sample 11 which does not add butyral resin, the surface electrode was ground after barrel finishing and it disappeared. By the thing using the electrode paste of the samples 1-10 which added the butyral resin of this invention, a surface electrode did not disappear after barrel finishing to it for the elasticity of butyral resin.

[0045] Then, after having heat-treated at the temperature of 400 degrees C in atmospheric air after drying the piece of an individual which carried out barrel finishing, and removing a binder, at 875 degrees C, it held for 30 minutes and calcinated. Next, it applied to the configuration of a request of the commercial silver electrode containing a glass frit on a side face as an external electrode, and at 750 degrees C, it held for 10 minutes and was able to be burned. The flow stabilized in the electrode paste which there is no peeling in the electrode on the rear face of a table, and added the butyral resin of this invention like the example 1 is possible.

[0046] Compared with the case where barrel finishing is performed after baking, after drying the plasticizer which is the manufacture approach of this invention, barrel finishing was performed, by calcinating after that, surface roughness decreased to one fifth, anti-chip box reinforcement improved 30%, and the very good property was acquired.

[0047] Moreover, it changed to the silver dust used for electrode paste, and the powder of gold, platinum, and palladium was pasted similarly, respectively, and although butyral resin was added and used, the same effectiveness as silver dust was acquired.

[0048] (Example 4) The layered product which formed the internal electrode and the table rear-face electrode like the example 1 was produced. In the size of 7mm long and the 5mm wide piece of an individual, the blade cutting edge was used and this layered product was cut. Atmospheric air is permuted for this by nitrogen using a dryer, it heat-treated for 3 hours and the plasticizer in a green sheet was made to remove the temperature of 200 degrees C in nitrogen.

[0049] Thus, by heat-treating in nitrogen, while drying the plasticizer in a green sheet, it becomes possible to control combustion of ethyl cellulose and butyral resin, and the desiccation stabilized even if it supplied the sample so much is attained.

[0050] Next, this cut layered product was put into the with a 600cm diameter [ 100mm diameter of the capacity of 3 ] poly pot, alumina balls with a diameter of 2mm and water were added, and barrel finishing was performed by part for 500 barrel engine-speeds/for 1 hour. By carrying out, before sintering barrel finishing, the angle was able to become round and the stable configuration was able to be acquired. On the other hand, when barrel finishing was carried out before heat treatment, the angle did not benefit the elasticity of the plasticizer in a green sheet round.

[0051] Moreover, in the thing using the electrode paste of the sample 11 which does not add butyral resin, the surface electrode was ground after barrel finishing and it disappeared. By the thing using the electrode paste of the samples 1-10 which added the butyral resin of this invention, a surface electrode did not disappear after barrel finishing to it for the elasticity of butyral resin.

[0052] Then, after having heat-treated at the temperature of 400 degrees C in atmospheric air after drying the piece of an individual which carried out barrel finishing, and removing a binder, at 875 degrees C, it held for 30 minutes and calcinated. Next, it applied to the configuration of a request of the commercial silver electrode containing a glass frit on a side face as an external electrode, and at 750 degrees C, it held for 10 minutes and was able to be burned. In the thing using the electrode paste of the sample 11 which does not add butyral resin, it remained, even after the configuration of exfoliation of the electrode before baking calcinating, and a flow was not able to be taken between an external electrode and some surface electrodes.

In the thing using the electrode paste of the samples 1-10 which added butyral resin on the other hand, the flow stabilized in the electrode paste which there is not, and exfoliation of the external electrode after baking does not have, either, and added the butyral resin of this invention was possible for exfoliation in the cutting plane of a surface electrode.

[0053] Compared with the case where barrel finishing is performed after baking, after drying the plasticizer which is the manufacture approach of this invention, barrel finishing was performed, by calcinating after that, surface roughness decreased to one fifth, anti-chip box reinforcement improved 30%, and the very good property was acquired.

[0054] Moreover, it changed to the silver dust used for electrode paste, and the powder of gold, platinum, and palladium was pasted similarly, respectively, and although butyral resin was added and used, the same effectiveness as silver dust was acquired.

[0055] (Example 5) Next, the manufacture approach of electronic parts of having used the internal beer hall for connection of an internal electrode is explained.

[0056] The silver paste made from Kyoto EREKKUSU (DD1411A-35) is first used for the front face for the grand pattern 105 of drawing 10 (d), and it printed with well-known screen printing, and was made to carry out the two-sheet laminating of 100mm long and the green sheet (MLS1000) by Nippon Electric Glass Co., Ltd. with a thickness [ of 100mm wide magnitude ] of 100 micrometers, and to dry. The laminating of the one green sheet was carried out to the top face, and the capacitor patterns 103 and 104 of drawing 10 (c) were screen-stenciled. Furthermore, the 14-sheet laminating of the green sheet was carried out to the top face, and the letter coil pattern 102 of a \*\* face crease of drawing 10 (b) was screen-stenciled.

[0057] Next, while connection of internal beer performed hole processing by punching with a diameter of 0.2mm to the position of a required green sheet and made alignment it, the silver paste was printed and dried through the metal mask so that only the part of the internal beer of the maximum upper layer might expose behind a laminating the green sheet in which each pattern was formed.

[0058] The two more sheet laminating of the green sheet was carried out to the last, and it screen-stenciled using the electrode paste which produced the surface electrode patterns 110-113 of drawing 10 (a) in the example 1 as a surface electrode in the maximum upper layer. Furthermore, the rear-face electrode patterns 114-117 of drawing 10 (e) were screen-stenciled as a rear-face electrode on the surface of the opposite hand, and the layered product in which a table rear-face electrode, an internal electrode, and internal beer were formed was produced.

[0059] Then, thermocompression bonding of this layered product was carried out for 1 minute by 80 degrees C and the pressure of 300kg/cm<sup>2</sup>. Laminating LC composite part as a cross section shows by this to drawing 8 and 9 was producible. In addition, drawing 6 is the circuit diagram of the laminating LC composite part of the example 5 of this invention, and drawing 7 is the perspective view of the laminating LC composite part of the example 5 of this invention.

[0060] Hereafter, the sample was produced by the same approach as examples 2, 3, and 4. The stable flow was possible for the thing using the electrode paste which added the butyral resin of this invention like examples 2, 3, and 4.

[0061] Compared with the case where barrel finishing is performed after baking, after drying the plasticizer which is the manufacture approach of this invention, barrel finishing was performed, by calcinating after that, surface roughness decreased to one fifth, anti-chip box reinforcement improved 30%, and the very good property was acquired.

[0062] Moreover, it changed to the silver dust used for electrode paste, and the powder of gold, platinum, and palladium was pasted similarly, respectively, and although butyral resin was added and used, the same effectiveness as silver dust was acquired.

[0063]

[Effect of the Invention] As mentioned above, while preventing the electrode exfoliation at the time of cutting of electronic parts by improving the presentation of electrode paste in this invention, after being able to prevent the electrode omission at the time of polish of electronic parts and removing a plasticizer, the electronic parts of high intensity can be obtained by performing barrel finishing before baking.

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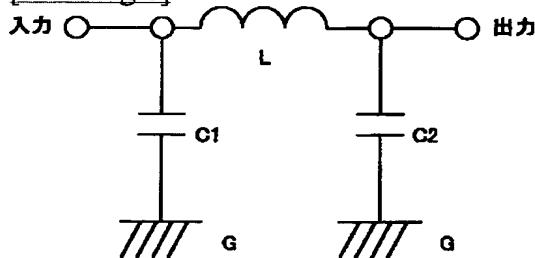
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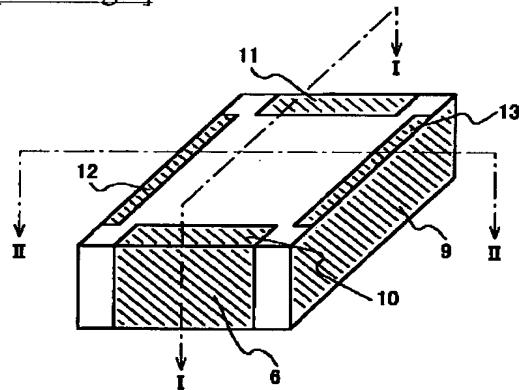
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## DRAWINGS

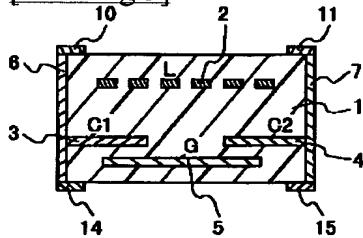
### [Drawing 1]



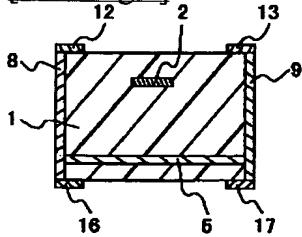
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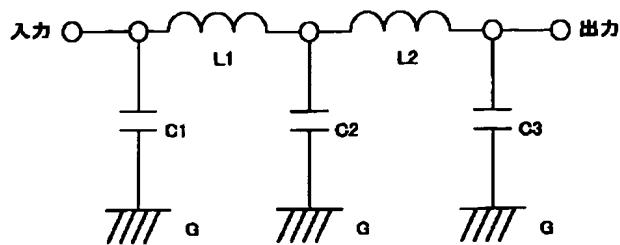
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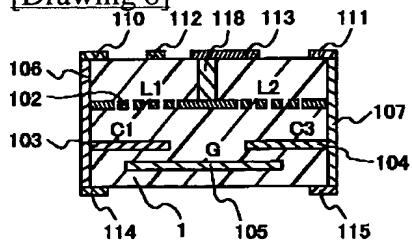
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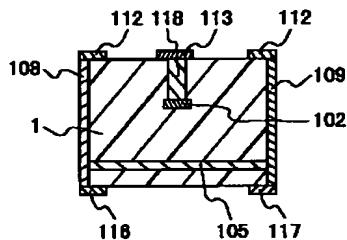
[Drawing 6]



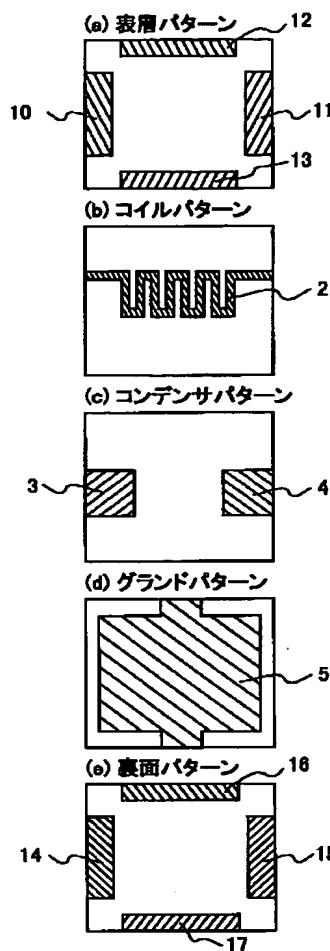
[Drawing 8]



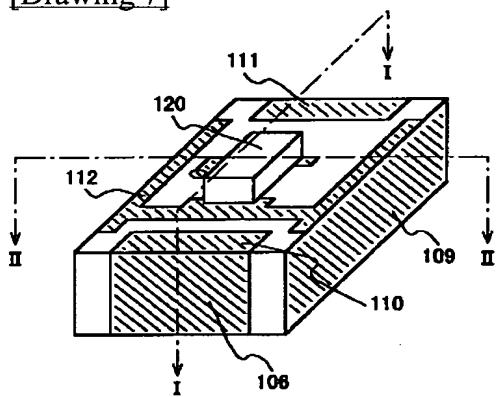
[Drawing 9]



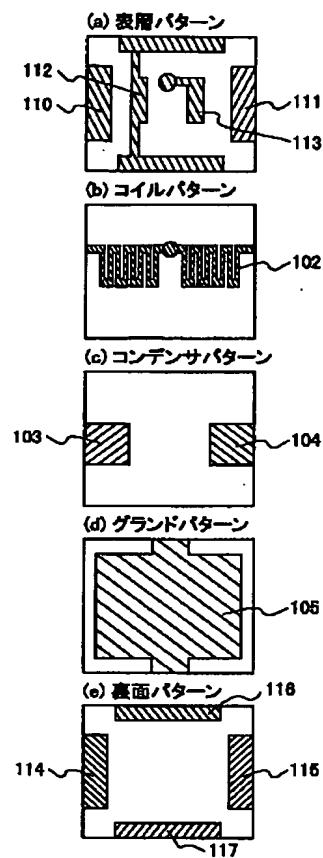
[Drawing 5]



[Drawing 7]



[Drawing 10]



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[Translation done.]